Certificates: Transition from Traditional Algorithms to PQC Algorithms

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Certificates and PQC Algorithms

Goal: Deploy PQC algorithms before there is a large-scale quantum computer that is able to break public key algorithms in widespread use today

Assumption: while people gain confidence in the PQC algorithms and their implementations, security protocols will use a mix traditional and PQC algorithms

Recognize: upgrading existing PKI will take a long time

Recognize: security protocols need to be updated, which will also take a long time

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Two Possible Approaches

1) Two certificates, each with one public key and one signature:
   - one certificate traditional algorithm, signed with traditional algorithm
   - one certificate PQC algorithm, signed with PQC algorithm

2) One certificate:
   - Multiple public keys – mix of traditional and PQC public keys
   - Multiple signatures – mix of traditional and PQC signatures

Public Key

SEQUENCE OF	Traditional public key
	PQC public key

Signature

SEQUENCE OF	Traditional signature
	PQC signature

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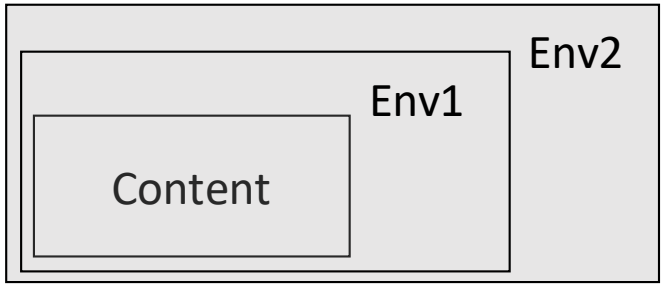
In both cases …

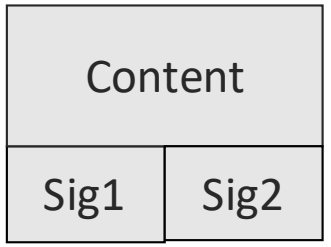
While people gain confidence in the PQC algorithms
and their implementations, security protocols should mix
traditional and PQC algorithms for confidentiality and authentication based on both

IPsec and TLS, use a KDF to compute shared secret from two inputs:

$$SS = KDF(SS_T, SS_{PQC})$$

S/MIME, could so the same ***OR*** use double encapsulation for confidentiality along with parallel signatures for authentication





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One Certificate

- Security protocols do not need any new fields
  - Additional public keys are in one certificate
  - Security protocols still need to be updated for the PQC algorithms
- No need to modify certificate architecture, but validation needs additional complexity to handle new corner cases …
  - Traditional signature fails but PQC is good – do what?
- Has known pitfalls of the “jumbo” certificate, which carried a key agreement public key and a signature public key for the same user
  - The “jumbo” certificate had fewer corner cases since there was only one signature public key
- Certificate becomes huge

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Two Certificates

- Security protocols need new field for the additional certificates
- No need to modify certificate architecture, and validation works exactly as it does today
- Avoid known pitfalls of the “jumbo” certificate
- Two certificates are slightly bigger than one, just because the subject, issuer, and other metadata are repeated in both
- At the end of the transition, just stop using the certificates with traditional algorithms

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My Recommendation

- Use separate certificates for traditional and PQC algorithms
- Begin the security protocol work now for mixing the two
- Plan for the day when only PQC algorithms are used


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